GONDWANA UNIVERSITY
GADCHIROLI

SYLLABI AND COURSE OF STUDY IN BIOTECHNOLOGY

BIOTECHNOLOGY COURSE

PG SEMESTER III
UNDER NEP-2020

From Session 2024 Onwards

GONDWANA UNIVERSITY, GADCHIROLI

FACULTY OF SCIENCE AND TECHNOLOGY

Master of Science in Biotechnology

Program Information

On completion of the course, the students are expected to be proficient in the fundamental, applied and modern areas of Biotechnology. They are expected to have acquired the skills of theoretical and practical aspects of different branches of biotechnology; to be able to develop rationale thinking skills, logical interpretation and analytical skills. Effective communication of scientific developments to the society at large is very critical attribute expected from the students of this course.

The outcomes expected **(PO)** from the post-graduates of M.Sc. Biotechnology program are:

PO1- Fundamental and advanced knowledge of biotechnology and its different branches

PO2- Orientation and specialization in at least one specific branch of biotechnology and related fields

PO3- Proficiency in theoretical and practical aspects of traditional as well as modern tools and techniques in the fields of biotechnology

PO4- Awareness and sensitization about various societal problems related to biotechnology

PO-5- Effective communication of scientific knowledge and recent developments with the society

PO-6-Acquiring skills of writing, editing and publication of research findings in reputed journals and magazines.

PO-7- Acquire skills and training in scientific communications and presentation

PO-8- Ability to design and undertake research projects to solve societal problems

Aims of Master Degree Program in Biotechnology

The objective of this course is to provide fundamental and advanced knowledge of biotechnology and its related subjects.

- To generate competent human resources skilled to contribute towards the sustainable development of industry, teaching, and research in different areas of Biotechnology.
- To develop a set of interdisciplinary professional skills that will enable the students in research and development in Biotechnology.
- To bring social, ethical, and professional awareness among the students about various issues of contemporary practices in biotechnology and related fields.

Qualification Descriptors

Upon successful completion of the course, the students receive a M.Sc. degree in Biotechnology. Biotechnology postgraduates are expected to branch out into different paths of seeking advanced research based knowledge, professional employment, or entrepreneurship that they find fulfilling. They will be able to demonstrate knowledge as well as skills in diverse fields of Biotechnology. This will provide a foundation, which shall help them to embark on research careers by attaining doctoral positions in coveted institutions, as well as securing employment in research projects in industry or institutes. Besides research, they can get suitable teaching positions in Colleges and Universities as an Assistant Professor after qualifying National Eligibility Test (NET). It is expected that besides the skills specific to the discipline, the wider life skills of analysis, logical reasoning, scientific aptitude, communication skills, research and life ethics, and moral values will be inculcated in the students.

The list below provides a synoptic overview of possible career paths provided by a postgraduate training in Biotechnology:

1. Research
2. Industry
3. Teaching
4. Biotechnology entrepreneurship
5. Administration and Policy Making
6. Scientific Communication
7. Patents and Law
8. Scientific Writing and Editing
9. Document preparation and publication

M. Sc. Biotechnology Program Specific Outcomes (PSO)

After completion of M.Sc. Biotechnology, the students will be able:

PSO –1 :To understand the basic principles and applications of biotechnology.

PSO– 2: To understand the principles of microbiology, animal biotechnology, plant biotechnology, genetic engineering, applied biotechnology involved in biotechnology to identify crucial biological problems.

PSO–3 :To realize the importance of laws and ethics in biotechnological practices and be able to practice good laboratory practices.

PSO–4: To handle basic, sophisticated advanced instruments needed in a research laboratory with ability to design and execute experiments with precision in a logical manner.

PSO–5: To understand theoretical as well as practical aspects of gene cloning, expression of recombinant proteins, tissue culture, and transgenic development.

PSO–6: To understand the basics of statistics and computational methods used in biological processes.

PSO–7:To understand the principles and applications of genomics, transcriptomics, and proteomics, and integrate the knowledge of genomics and genetic engineering to address problems of healthcare, cropimprovement, energy and environment.

PSO–8: To understand the principles and applications of bioprocess designing, pharmaceutical biotechnology, and nanotechnology for solving problems of biology and other related sciences.

PSO-9: To launch start-ups and become entrepreneurs for novel biotechnology products and processes in various industries.

PSO-10: To understand Bio safety measures, Ethical issues and regulatory compliances in the field of Biotechnology and effective scientific communication

Gondwana University, Gadchiroli

NEP 2020 P.G. PROGRAMME SESSION 2024-25

Faculty of Science and Technology

Program Name - M.Sc. Sem-III (Biotechnology)

Sr. No.	Course Category	Subject Name	Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Marks
							Theory					Practical				
				Theory	Pract	Total Hrs.	UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Passing	
1	Major	Subject-1 Animal Biotechnology	04	04	--	04	80	20	100	40	03	--	--	--	--	100
2		Subject-2 Plant Biotechnology	04	04	--	04	80	20	100	40	03	--	--	--	--	100
3		Subject-3 Genetic Engineering	04	04	--	04	80	20	100	40	03	--	--	--	--	100
4		Practical-I Based on subject1,2,3	02	-	04	04	-	-	-	-	-	30	20	50	25	50
5	Major (Elective)	Any one from Elective basket	02	02	--	02	40	10	50	20	02	--	--		25	50
6		Practical-II Based on Elective Paper	02	-	04	04	-	-	-	-	-	30	20	50	25	50
7		Research Project	04	--	08	08	--	--	--	--	--	60	40	100	50	100
Total			22	14	16	26	280	70	350	-	-	120	80	200	125	550

M.Sc. Biotechnology (PG) Program

Faculty of Science and Technology

(Affiliated Colleges)

(W.e.f. Academic Year 2024-25)

Scheme of Teaching and Examination under Semester Pattern for M.Sc. Program in

Biotechnology

<table>
<tr><th>SEM</th><th>Core Course</th><th>Elective</th><th>Research Project</th></tr>
<tr><td rowspan="4">SEM III</td><td>Major 1- STPG03BTH001
(4 Credits) (4Hours/Week)</td><td rowspan="3">STPG03BTH004 to STPG03BTH008

Elective Course - Student shall select any one course.
(2 Credits) (2Hours/Week)</td><td rowspan="3">STPG03BTH009
Research Project
(4 Credits) (4Hours/Week)</td></tr>
<tr><td>Major 2 – STPG03BTH002
(4 Credits) (4Hours/Week)</td></tr>
<tr><td>Major 3 – STPG03BTH003
(4 Credits) (4 Hours/Week)</td></tr>
<tr><td colspan="2">Practical – I (50 Marks) STPG03BTH010
Based on Major Course only
(4 Hours/Week)
(2 Credit)
Practical – II (50 Marks) STPG03BTH011
Based on Elective Course only(4Hours/Week)
(2 Credit)</td><td></td></tr>
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Total 22 Credits

Teaching and Examination Scheme

M.Sc. Semester III

Master of Science (Biotechnology)

Gondwana University, Gadchiroli

Faculty Name : Science and Technology **Name P.G.: BIOTECHNOLOGY**

Two Years Regular Post Graduate Program

SEM – III

Major (Mandatory)	Credit	Elective	Credit	Research Project	Credit	Total Credit
1. Animal Biotechnology (STPG03BTH001) Paper - I Theory = 100 (UA80 + CA20) **04Credit**	(4x3)12	1.**Applied Biotechnology,** Paper – IV**(STPG03BTH004)** Theory = 50 (UA40 + CA10) **02 Credit**	2	**Research Project STPG03BTH 009** Project = 80 Viva = 20	4	**22**
		2.**Molecular Diagnostic**, Paper - IV **(STPG03BTH005)** Theory = 50 (UA40 + CA10) **02 Credit**				
2. **Plant Biotechnology (STPG03BTH002)** Paper - II Theory = 100 (UA80 + CA20) **04credit**		3.**Clinical Trial And Research,** Paper – IV**(STPG03BTH006)** Theory = 50 (UA40 + CA10) **02 Credit**				
		4.**Phytosecondary Metabolite And Its Bioactivity**, Paper - IV**(STPG03BTH007)** Theory = 50(UA40 + CA10) **02 Credit**				
3.**Genetic Engineering– (STPG03BTH003)** Paper -III Theory =100 (UA80 + CA20) **04credit**		5 **Genomics and Proteomics**, Paper - IV**(STPG03BTH008)** Theory = 50 (UA40 + CA10) **02 Credit**				
Practical I-(50 Marks) Based on Paper 1,2 & 3 (4Hours/Week) **(02credit) STPG03BTH010** **Practical – II (50 Marks) STPG03BTH011** Based on Elective Course only (4Hours/Week) **(2Credit)**	(2x2)4	**Note:- Student shall select anyone from above group**				

Master of Science (Biotechnology)

M.Sc. Semester III

Assessment and Evaluation		
Suggested Continuous Evaluation Methods:		
Internal Assessment (Theory**)** Continuous Internal Evaluation (CIE)	Class Test, Attendance, Assignment (Charts/Models/Seminar/Rural Service/Report of Excursion/Lab visit/Industrial visit/project orreview work)	20
	Total	**20**
External Assessment Practical Exam	Experimentation, *Viva Voce*, Spotting *e*tc.	30
Practical Internal	Practical Record and others	20
	Total	**50**
External Assessment University Theory Exam	Section (A) – one Long Question Or Two brief questions	16 X 1=16 8 X 2 = 16
	Section (B) – one Long Question Or Two brief questions	16 X 1=16 8 X 2 = 16
	Section (C) – one Long Question Or Two brief questions	16 X 1=16 8 X 2 = 16
	Section (D) – one Long Question Or Two brief questions	16 X 1=16 8 X 2 = 16
	Section (E) – Four Short Question	4 X 4 = 16
	Total	**80**
Project/Dissertation	Project work	80
	Presentation/VIVA	20
	Total	**100**

General Rules and Regulations Regarding Pattern of Question Paper for the Semester End Examination:

A) Pattern of Question Paper for Major Paper

1. Maximum marks of each theory paper will be **80.**
2. Question paper will consist of five questions, each of **16** marks.
3. Four questions will be on four units with internal choice (One question on each unit).
4. Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.

B) Pattern of Question Paper for Elective Paper

1. Maximum marks of elective theory paper will be **40.**
2. Question paper will consist of five questions, each of **8** marks.
3. Four questions will be on four units with internal choice (One question on each unit).
4. Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.

C) Practical Examination

1. Practical – I & II carry **50** marks. The scheme of marking consists of external assessment of **30** marks and internal assessment **20** marks.
2. Practical performance shall be jointly evaluated by the External and Internal Examiner.
3. Duration of practical examination will be as per given in the syllabi of respective subjects.

D) Project/Dissertation – Students have to prepare and submit the work (Synopsis)based on following criteria

1. Selection of topic
2. Abstract
3. Introduction/Statement Finding
4. Literature Review
5. Plan of work/Methodology
6. Conclusion including Scope and Limitation of Study
7. References/Bibliography

The project/dissertation will be of 100 marks which consist of **80** marks for synopsis work and **10** for presentation of synopsis & **10** marks for seminar on any one topic from syllabus. Students have to prepare a project file as a synopsis and submit to the head of the department.

Distribution of Marks for Practical for Sem III & IV : Total marks : 30 **Duration: 04 Hrs**

1. **Major experiment ---------- 10**
2. **Minor Experiment (2x5)----------10**
3. **Practical Record----------05**
4. **Viva-voce---------- 05**

Total : 30

Internal Assessment Marks : 20 (Based on Attendance, Punctuality, Lab Assignment Submission, Tour/ Field Visit Diary Submission

COURSE OUTCOMES AND COURSE CONTENT

Semester	**III**
Paper Code	**STPG03BTH001**
Paper Title	**Animal Biotechnology**
Number of teaching hours per week	**4 Hours per week**
Total number of teaching hours per semester	**60**
Number of credits	**4**

Course Outcomes:
Importance and history of in vitro culture, nutritional requirement, media components, Basal and Supplemented animal cell culture, Sterilization Techniques Scaling up of animal scale culture Application of animal cell culture

Unit I: Introduction to Animal Cell Culture	**15Hrs**
A. Animal cell culture: Equipment and materials for animal cell culture technology, various systems of tissue culture, advantagesand limitations. B. Culture media: Natural media, synthetic media, balanced saltsolutions. C. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, role of CO2,serum and supplements. D. Characteristics of cells in culture: contact inhibition, anchoragedependence, cell-cell communication	
Unit II: Methods of Animal Cell and Tissue Culture	**15Hrs**
A. Isolation of animal cell material: various methods of separation of cell types, advantages and limitations. B. Primary culture: behavior of cells, properties, utility, explant culture; suspension culture. C. Established cell line cultures: definition of cell lines, maintenance and management; cryopreservation, germplasm conservation, cell adaptation. D. Three dimensional cultures	
Unit III: Scaling up of Animal Cell Culture	**15Hrs**
A. Apoptosis: measurement of cell death. apoptosis (death domain, role of cytochrome C) B. Cell synchronization and cell manipulation C. Cell transformation, cell cloning D. Tissue engineering- design and engineering of tissue, tissue modeling. E. Stem cell cultures, embryonic stem cells and their applications	
Unit IV: Application of Animal Tissue Culture	**15Hrs**
A. Mass production of biologically important compounds (eg. vaccines), cytotoxicity and diagnostic tests. B. Manipulation of reproduction in animals: artificial insemination, embryo transfer (multiple ovulations, multiple ovulations with embryo transfer) C. In vitro fertilization technology: embryo cloning and embryonic stem cell. embryo transfer in human. D. Application of animal cell culture: transgenic animals- mice, large animals, xenotransplantation, use of transgenic animals in disease interruption.	

Suggested Readings

1. Animal Biotechnology, M.M. Ranga, Himalaya Publishing House, 2007
2. Animal Cell Culture, John R. W. Masters, Oxford Uni. Press Newyork,2007
3. Biotechnology, B. D. Singh, Kalyani Publication Ludhiana2007
4. Biotechnology, Mohan P. Arora, Himalaya Publishing House,2007
5. Culture of Animal Cells, Ian Freshney, A John Willey 2007
6. Animal Cell Culture, John R. W. Masters, Oxford Uni. Press Newyork,2000

Semester	**III**
Paper Code	**STPG03BTH002**
Paper Title	**Plant Biotechnology**
Number of teaching hours per week	**4**
Total number of teaching hours per semester	**60**
Number of credits	**4**

COURSE OBJECTIVES:

Introduction to cell and tissue culture techniques
Understand the techniques of plant tissue culture
Plant transformation Technology, Mechanism of DNA transfer
Application of plant tissue culture

Unit I: Introduction to Plant Tissue Culture	15 Hrs
A. Brief introduction to conventional plant breeding B. Introduction to cell and tissue culture technique. C. Tissue culture media (composition and preparation) D. Role of growth hormone in plant tissue culture (auxins, cytokinin) E. Callus and suspension cultures: initiation and maintenance ofcallus and suspension cultures; single cell clones.	
Unit II: Techniques of Plant Tissue Culture	15 Hrs
A. Organogenesis. embryogenesis; transfer and establishment of whole plants in soil. B. Shoot tip culture: rapid clonal propagation and production of virus free plants. C. Embryo culture and embryo rescue. D. Hybrid plants: protoplast isolation, culture and fusion. E. Selection of hybrid cells and regeneration of hybrid plants, symmetric and asymmetric hybrid, cybrid. F. Production of haploid plants: anther and pollen cultures for production of haploid plants	
Unit III: Plant Transformation Technology	15 Hrs
A. Basis of tumor formation, hairy root. B. General features of Ti and Ri plasmids. C. mechanism of DNA transfer, role of virulence genes, use of Ti and Ri as vectors, binary vectors. D. Methods of nuclear transformation, biological and physical transformation methods. E. Chloroplast transformation.	
Unit IV: Application of Plant Tissue Culture	15 Hrs
A. Applications of plant transformation for productivity and performance B. Herbicide resistance -phosphoinothricine glyphosate, sulfonyl urea, atrazin C. Insect resistance- Bt genes. D. Virus resistance, coat protein mediated nucleocapsid gene. E. Fungal resistance, disease resistance, nematode resistance. F. Improvement of crop yield and quality - Long shelf life of fruits and flowers. G. Male sterile lines. H. Transgenic plants as a food- golden rice, pomato, sugarcane, sweet corn.	

Suggested Readings

1. Plant Biotechnology-Practical Manual, C.C.Giri, Archana Giri,I.K.Int.Pub House 2007
2. An Introduction To Molecular Biotecnology, Michel Wink, Wiley VchVerlog Pub. 1999
3. Plant Biotechnology And Its Application, Ashavini Kumar, Shekha Roy,I.K.Int.Pub House 2007
4. Plant Physiology, Lincoln Talz, Sinaduar Assosiates, 2006
5. Plant Biotechnology, K. G. Ramawat, S.Chand, 2008
6. Text Book Of Biotechnology, R. C. Dubey, S. Chand, 2009

Semester	**III**
Paper Code	**STPG03BTH003**
Paper Title	**Genetic Engineering**
Number of teaching hours per week	**4**
Total number of teaching hours per semester	**60**
Number of credits	**4**

COURSE OBJECTIVES:

Describe fundamental molecular principle of genetics
Genetic engineering and gene selection
Cloning vectors and rDNA preparation
Insertion of foreign DNA into host cell

Unit I: Introduction to Genetic Engineering and Gene Selection	15Hrs
A. Isolation of DNA from the source (plant, animal, microbes) B. DNA manipulation enzymes: nucleases (exonucleases andendonucleases), ligases, polymerases and topoisomerases. C. Restriction enzymes and their types, restriction modificationsystem, DNA modification enzymes D. Gene isolation and purification: general methods (shotgun method for producing gene library, cloning specific genes by hybridization and reverse transcriptase methods, direct selectionof a gene	
Unit II: Cloning Vectors and rDNA Preparation	15Hrs
A. Cloning vectors: plasmids as vectors, general characteristics of plasmids, bacterial vector plasmids, yeast vector plasmids, yeast artificial chromosomes. viral vectors (lambda, M13). Cosmids vectors, phagemid vectors. B. Insertion of DNA and ligation: Berg's terminal transferase method (dA:dT joints); Boyer-Cohen-Chang experiment (cohesive ends), butt joints (T4 DNA ligase); current ligation techniques (blunt-end ligation, complementary end ligation) linkers, adaptors, homopolymer tailing.	
Unit III: Molecular Probe and DNA Sequencing	15Hrs
A. Gene libraries and molecular probes: molecular probes for detecting nucleic acids and proteins. genomic DNA library, cDNA library. B. Nucleic acid hybridization (southern hybridization, northern hybridization). Antibody probes (western blotting, immunoprecipitation and south-western screening). C. DNA sequencing: Sanger-Coulson dideoxynucleotide method, Maxam-Gilbert chemical cleavage method, multiplex DNA sequencing, automated DNA sequencing.	
Unit IV: Insertion of Foreign DNA into Host Cell	15Hrs
A. Transformation: DNA uptake by bacterial cells. B. Transfection: chemical and physical methods, viral vectors. polyethylene glycol, DEAE-dextran, calcium phosphate coprecipitation, dimethyl sulfoxide, liposomes, microinjection,microinjection, electroporation, bilistics, somatic cell fusion,viral vectors (single- and two-strain packaging). C. Gene transfer by pronuclear microinjection	

Suggested Readings

1. Genes Vi, Benjamin Lewin, Oxford Uni. Press Newyork, 1998
2. Molecular Biology-I Recombinant Dna, T. A. Brown, Academic Press,1998
3. Molecular Cloning Vol-I, Sambrook And Russel, Cold Spring HarborLab. Press, 2007
4. Comprehensive Biotechnology, Ramawat K. G., Shaily Goyal, S. Chand,2001
5. Techniques In Life Sciences, Dr. D. B. Tembhare, Himalaya Publication,2004
6. Genes Vi, Benjamin Lewin, Oxford Uni. Press Newyork, 1998
7. Molecular Biology-I Recombinant Dna, T. A. Brown, Academic Press,

ELECTIVE PAPERS

Semester	**III**
Paper Code	**STPG03BTH004**
Paper Title	**Applied Biotechnology**
Number of teaching hours per week	**2**
Total number of teaching hours per semester	**40**
Number of credits	**2**

COURSE OBJECTIVES:

Expression of foreign gene bacteria, yeast, insect and mammalian cells, Gene amplication and Expression Gene theory and Therapeutic products, Production of commercial by GMOs. Introduction of metabolits and Nanotechnology

Unit I : Gene Amplification and Expression	10Hrs
A. Salient features of expression vectors. B. Expression of foreign gene: expression of eukaryotic genes in bacteria, expression of foreign genes in yeast, insect and mammalian cells. C. Processing of recombinant proteins: refolding and stabilization. D. Protein engineering- addition of disulphide bond, changing amino acids, modification of metal cofactors, changing protease activity, active site modification. E. Amplification of DNA: polymerase chain reaction	
Unit II : Gene Theory and Therapeutic Products	10Hrs
A. Production of monoclonal bodies by phage display technique using filamentous phage vectors. B. Gene therapy: somatic and germline, random and targeted gene replacement, in vivo and ex vivo gene delivery, retrovirus gene transfer system, advantages and disadvantages of adenovirus, adeno-associated virus, herpes virus vectors, gene correction, replacement/augmentation, editing, regulation and silencing. Gene therapy of human diseases	
Unit III : Production of Commercial Products by GMOs	10Hrs
A. Role of rDNA technology in production of alcohol B. Role of rDNA technology in production of vitamin- (ascorbic acid, vitamin B12) C. Role of rDNA technology in production of vaccine- (vaccinia viral vaccine, polio vaccine) D. Role of rDNA technology in production of hormone- (insulin, oxytocin) E. Role of rDNA technology in production of antibiotics- (streptomycin, penicillin)	
Unit IV : Plant Secondary Metabolits and Nanotechnology	10Hrs
A. Plant secondary metabolites: phenylpropanoid pathway, shikimate pathway, alkaloids, industrial enzymes, biodegradable plastics, polyhydroxybutyrate, therapeutic proteins, lysosomal enzymes, oleosin partitioning technology. B. Green house technology: principle and application C. Concept of nanobiotechnology and application of nanobiotechnology in medicine	

Suggested Readings

1. Biotechnology, B. D. Singh, Kalyani Pub, 2007
2. Comprehensive Biotechnology, Ramawat K. G., Shaily Goyal, S. Chand, 2001
3. Techniques In Life Sciences, Dr. D. B. Tembhare, Himalaya Publication, 2004
4. Industrial Biotechnology, S. N. Jogdand, Himalaya Publishing House, 2006
5. Advances In Biotechnology, S. N. Jogdand, Himalaya Publishing House, 2007
6. Biotechnology, B. D. Singh, Kalyani Publication Ludhiana2007
7. Biotechnology, Mohan P. Arora, Himalaya Publishing House,2007
8. Biotechnology Laboratory Course, Bucker, Open University Publ, 2004
9. In vitro Cultivation Of Of Animal Cells, Butte
10. Rworth,Heinemanm, Open University Publ, 2004
11. Biotechnological Innovations In Animalproductivity, Utterworth, Heinemanm, Open University Publ, 2004

Semester	**III**
Paper Code	**STPG03BTH005**
Paper Title	**Molecular Diagnostic**
Number of teaching hours per week	**2**
Total number of teaching hours per semester	**40**
Number of credits	**2**

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COURSE OBJECTIVES

1. Acquire knowledge and understanding of the fundamentals of genomics and proteomics,transcriptomics, and metabolomics.
2. Apply the knowledge to various applied areas of biology.
3. Develop recombinant proteins as well as primers as tools for developing diagnostics kits.
4. Get acquainted with current technologies being developed and used in clinic and research

Unit I : Genome biology in health and disease	10 Hrs
A. DNA, RNA, Protein B. chromosomal structure & mutations; C. DNA polymorphism: humanidentity; clinical variability and genetically determined adverse reactions to drugs.	
Unit II : Genome: resolution, detection & analysis	10 Hrs
A. PCR: Real-time B. Nucleic acid sequencing: new generations of automated sequencers; Microarray chips; EST; SAGE; microarray data normalization & analysis molecular markers: 16S rRNA typing; C. Diagnostic proteomics: SELDI-TOF-MS & MALDI-TOF ; Bioinformatics data acquisition & analysis	
Unit III : Molecular markers based diagnosis	10 Hrs
A. Preliminary concept of RFLP, RAPD, AFLP. B. Molecular markers linked to disease resistant genes, C. application of RFLP in forensic, disease prognosis, genetic counselling, pedigree, varietals etc., D. Germplasm maintenance, taxonomy and Biodiversity. E. Genome size, Genome mapping by conjugation, organelle genome with concept of DNA barcoding, and cloning in organelle genome. F. Genetic defects due to mutations in the organelle genome.	
Unit IV : Detection of inherited diseases	10 Hrs
A. Exemplified by two inherited diseases for which molecular diagnosis has provided a dramatic improvement of quality of medical care: Fragile X Syndrome: B. Paradigm of new mutational mechanism of unstable triplet repeats, von-Hippel Lindau disease: recent acquisition in growing number of familial cancer syndromes	

Suggested Readings

1. Primrose, S. B., Twyman, R. M., Primrose, S. B., & Primrose, S. B. (2006). Principles Of Gene Manipulation And Genomics. Malden, Ma: Blackwell Pub.
2. Liebler, D. C. (2002). Introduction To Proteomics: Tools For The New Biology. Totowa, Nj: Humana Press.
3. Campbell, A. M., & Heyer, L. J. (2003). Discovering Genomics, Proteomics, And Bioinformatics. San Francisco:Benjamin Cumming

Semester	**III**
Paper Code	**STPG03BTH006**
Paper Title	**Clinical Trial and Research**
Number of teaching hours per week	**2**
Total number of teaching hours per semester	**40**
Number of credits	**2**

COURSE OBJECTIVES

Regulatory guidelines and Quality assurance, Fundamental clinical research, good clinical research, different phases of clinical trial international council for Harmonization, Food and drug administration

Unit I : Clinical trial Introduction:	10 Hrs
A. Fundamentals of clinical research, B. Introduction to healthcare, C. Introduction to Good Clinical practices, D. Introduction to New Drug Development process, E. Preclinical studies: Selection of animals, selection of doses, protocol preparation and execution. F. Different phases of clinical trials: Phase I, Phase II, Phase III,	
Unit II : Regulatory Guidelines and Quality assurance	10 Hrs
A. Clinical Research regulations in India – CDSCO / ICMR guidelines, Schedule Y, Clinical trial application requirements in India, , B. International Council for Harmonization (ICH), C. United states-Food and Drugs administration (US-FDA), D. Medicines and Healthcare Products Regulatory Agency (MHRA) and Clinical Research regulations in Europe (EMEA). E. Quality Assurance and Quality Control in Clinical Trials,	
Unit III - Clinical Trial Ethics and safety	10Hrs
F. Ethics committees, G. constitution and practices, H. Declaration of Helsinki and Informed consent process, Liability and indemnity in clinical trials (Insurance and Indemnity: roles and responsibility), I. Ethics and clinical trials in special population.	
Unit IV: Scientific Writing and data management:	10 Hrs
A. Clinical Protocols, B. Clinical Data Management (CDM) C. Data management plan, Study set-up, Data entry, D. CRF tracking and corrections, Central lab, E. Quality Control and Quality Assurance in CDM, Data mining and warehousing Clinical Data Analysis.	

Suggested Readings

1. Lawrence M. Friedman, Curt D. Furberg, David DeMets. Fundamentals of Clinical Trials. Springer Cham.
2. Warren S. Browner. Publishing and Presenting Clinical Research, Third Edition. Lippincott Williams & Wilkins (LWW)
3. Dr. Stephen B Hulley, Steven R Cummings, Warren S Browner. Designing Clinical Research. Lippincott Williams & Wilkins (LWW)
4. Susanne Prokscha. Practical Guide to Clinical Data Management, Third Edition. CRC Press

Semester	**III**
Paper Code	**STPG03BTH007**
Paper Title	**Phyto Secondary Metabolite and Its Bioactivity**
Number of teaching hours per week	**2**
Total number of teaching hours per semester	**40**
Number of credits	**2**

Unit I : Strategies For Discovery Of Bioactive Phytochemicals	10 Hrs
A. Strategies For Discovery Of Bioactive Phytochemicals, B. Strategies For Choosing A Plant SpeciesOr Plant Tissue, C. Tools For Determination Of Active Components From Plants, D. Isolation And Characterization Of Plant Constituents, E. Phytochemical Analysis And Assay	
Unit II : QSAR And Molecular Modelling of Bioactive Phytochemicals	10 Hrs
A. Lignans And Tannis, As Antiviral And Antitumour Agents B. Isoflavonoids As Phytoestrogens And Flavonoids As Antiestrogens C. Antioxidants Phenolics: Physiochemical Properties D. Curcumins And Related Compounds As Blockers Of Signal Transduction In InhibitionOf Tumour Promotion E. Bioactive Components For Treatment Of Diseases.	
Unit III : Phyto-Antimicrobial (PAM)	10 Hrs
A. Phyto-Antimicrobial (PAM)- Agents As Multifunctional Food Additives B. PAM From Oils; PAMFrom Spices C. PAM From Herbs (Alove) PAM Thiosulphonates From Garlic D. PAM Polyphenolics From Green Tea	
Unit IV : Phytobioactives From Plants	10 Hrs
A. Phytobioactives From Plants, B. Their Compositions And Original Constituents, Natural Extracts C. Specific Process Development Require High Performing Technology Such As Extraction With Supercritic CO2 D. Enzymatic Biopurification Or Bioconversion E. Characterizing Fraction And Components By Analytical Methods Including HPLC, TLC, Flurometry And Spectrophotometry.	

Suggested Readings

1. Anita Patil (2020). Phytosecondary metabolites: isolation, characterization and their biological properties. STUDERA PRESS ISBN 978-93-85883-19-4
2. Crozier Alan Et.Al (2013). Plant Secondary Metabolites Occurrence Structure and Role In The Human Diet by Crozier Alan Et.Al, Wiley India Pvt Ltd
3. Mohammed Wasim Siddiqui, Kamlesh Prasad (2016). Plant Secondary Metabolites, Biological and Therapeutic Significance. Volume 1. CRC Press
4. Mohammed Wasim Siddiqui, Vasudha Bansal, Kamlesh Prasad (2016). Plant Secondary Metabolites, Stimulation, Extraction, and Utilization. Volume 2. CRC Press

Semester	**III**
Paper Code	**STPG03BTH008**
Paper Title	**Genomics and Protomics**
Number of teaching hours per week	**2**
Total number of teaching hours per semester	**40**
Number of credits	**2**

COURSE OBJECTIVE

- Acquire knowledge and understanding of the fundamentals of genomics and proteomics,transcriptomics, and metabolomics.
- Apply the knowledge to various applied areas of biology.
- Develop recombinant proteins as well as primers as tools for developing diagnostics kits.
- Develop recombinant therapeutics, Biopharmaceuticals and Biosimilars
- Design and develop Genetically modified as well as genetically edited plants
-

Unit I : Basics of genomics and Genome mapping	10 Hrs
A. A brief overview of prokaryotic and eukaryotic genome organization B. extra-chromosomal DNA: bacterialplasmids, mitochondria, and chloroplast. C. Genetic and physical maps; markers for genetic mapping; methods and techniques used for gene mapping, physical mapping, linkage analysis, cytogenetic techniques in situ hybridization, comparative gene mapping.	
Unit II : Genome sequencing projects	10 Hrs
A . Human Genome Project, B. genome sequencing projects for microbes, plants, and animals, C. metagenomes, accessing and retrieving genome project information from the web.	
Unit III : Comparative genomics	10Hrs
A. Identification and classification of organisms using molecular markers- 16S rRNA typing/sequencing, SNPs B. Use of genomes to understand evolution of eukaryotes, C. Track emerging diseases and design new drugs D. Determining gene location in genome sequence.	
Unit IV : Functional genomics and proteomics	10 Hrs
A. Transcriptome analysis for identification and functional annotation of gene, B. Chromosome walking and characterization of chromosomes, C. Mining functional genes in genome, gene function- forward and reverse genetics, gene ethics; protein chips and functional proteomics; D. Clinical and biomedical applications of proteomics; E. Introduction to metabolomics, lipidomics, metagenomics and systems biology. Types of assays used like 3C etc.	

Suggested Readings

1. Primrose, S. B., Twyman, R. M., Primrose, S. B., & Primrose, S. B. (2006). Principles of Gene Manipulation and Genomics. Malden, MA: Blackwell Pub.
2. Liebler, D. C. (2002). Introduction to Proteomics: Tools for the New Biology. Totowa, NJ: Humana Press.
3. Campbell, A. M., & Heyer, L. J. (2003). Discovering Genomics, Proteomics, and Bioinformatics. San Francisco:Benjamin Cummings.

Practical Based on Major Paper 1,2 & 3
Course Code: STPG03BTH010
02credit

Practical- I (ANIMAL, PLANT BIOTECHNOLOGY AND GENETIC ENGINEERING)

Compulsory Practical

1. Callus propagation, Organogenesis.
2. Development of primary cell lines/ maintenance of established cell lines.
3. Plant protoplast isolation, fusion and protoplast culture.
4. Recombinant DNA technology: in vitro DNA ligation and transformation of *E. coli*

Optional Practical

1. Preparation of animal cell culture media.
2. Initiation of primary culture from chick embryo
3. Preparation of single cell suspension from spleen /liver / thymus.
4. Cell counting and cell viability.
5. Trypsinization of monolayer and subculturing.
6. Preparation of plant tissue culture media.
7. Surface sterilization.
8. Organ culture.
9. Anther culture: production of haploids.
10. Micropropagation of banana/citrus/papaya/sugarcane.
11. Embryo culture of different plant species
12. Effect of various growth hormones on cell divisions and cell proliferation
13. Cytological examination of regenerated plants
14. Agrobacterium culture and selection of transformants.
15. Hardening of tissue culture raised plants
16. Recombinant DNA technology: characterization of transformants
17. Cell transformation by viruses.
18. Northern blotting
19. Preparation of probes
20. Isolation of lambda phage DNA.
21. Construction of restriction map of plasmid DNA.
22. Cloning in plasmid/phagemid vectors.
23. Replica plating technique.
24. Production of rDNA by ligation method.
25. Extraction of DNA from plant source

Note: In addition to the 3 compulsory practicals, at least 6 optional practicals must be conducted within the semester.

Practical Based on Elective Paper Applied Biotechnology
Course Code: STPG03BTH011
02credit

Practical-II (Applied Biotechnology**)**

Compulsory Practical

1.Demonstration of technique of PCR
2. Estimation of Plant secondary metabolites.

Optional Practical

1. Gene expression in *E. coli* and analysis of gene product.
2. Demonstration of technique of RT-PCR.
3. Induction of beta-galactosidase in strains of E. coli (I+ and I-).
4. Production of polyhydroxybutyrate (PHB) and its analysis.
5. Production of industrial enzyme and its biochemical assay.
6. Production of alcohol and it's analysis.
7.Production of ascorbic acid and it's analysis.
8.Gene expression in *S. cerevisiae* and analysis of gene product.
9.Demonstration of Digital PCR.

Note: In addition to the 2 compulsory practicals, at least 6 optional practicals must be conducted within the semester.

SEMESTER - IV

Gondwana University, Gadchiroli

NEP 2020 P.G. PROGRAMME SESSION 2024-25

Faculty of Science and Technology

Programme Name - M.Sc. Sem IV (Biotechnology)

Sr. No.	Course Category	Subject Name	Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Marks
							Theory					Practical				
				Theory	Practical	Total Hrs.	UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Passing	
1	Major	Subject-1 Environmental Biotechnology	04	04	--	04	80	20	100	40	03	--	--	--	--	100
2		Subject-2 Applied Environmental Biotechnology And Ecology	04	04	--	04	80	20	100	40	03	--	--	--	--	100
3		Pract-I	02	-	04	04	-	-	-	-	-	30	20	50	25	50
4		Prac-II	02	-	04	04	-	-	-	-	-	30	20	50	25	50
5	Major (Elective)	Any one from Elective Basket	04	04	--	04	80	20	100	40	03	--	--	--	--	100
		Research Project	06	--	12	12	--	--	--	--	--	90	60	150	75	150
Total			22	12	20	32	240	60	300	-	-	150	100	250	125	550

Gondwana University, Gadchiroli

NEP 2020 P.G. PROGRAMME SESSION 2024-25

Faculty of Science and Technology

Programme Name -M.Sc. Sem IV (Biotechnology)

<table>
<tr><th>SEM</th><th>Core Course</th><th>Elective</th><th>Research Project</th></tr>
<tr><td rowspan="4">SEM IV</td><td>Major 1- STPG04BTH001
(4 Credits) (4Hours/Week)</td><td rowspan="2">STPG04BTH003 to STPG04BTH007
Elective Course - Student shall select any one course.
(4 Credits) (4Hours/Week)</td><td>STPG04BTH008
Research Project
(6 Credits) (4Hours/Week)</td></tr>
<tr><td>Major 2 – STPG04BTH002
(4 Credits) (4Hours/Week)</td><td></td></tr>
<tr><td colspan="2">Practical – I (50 Marks) STPG04BTH009
Based on Major I Course only(4 Hour/Week)
(2 Credit)
Practical – II (50 Marks) STPG04BTH010
Based on Major II Course only(4 Hour/Week)
(2 Credit)</td><td></td></tr>
<tr><td colspan="2">Total 22 Credits</td><td></td></tr>
</table>

Teaching and Examination Scheme

M.Sc. Semester IV

Master of Science (Biotechnology)

<table>
<tr><td colspan="7">Gondwana University, Gadchiroli</td></tr>
<tr><td colspan="4">Faculty Name : Science and Technology</td><td colspan="3">Name P.G.: BIOTECHNOLOGY</td></tr>
<tr><td colspan="7">Two Years Regular Post Graduate Program</td></tr>
<tr><td colspan="7">SEM – IV</td></tr>
<tr><td>Major (Mandatory)</td><td>Credit</td><td>Elective</td><td>Credit</td><td>Research Project</td><td>Credit</td><td>Total Credit</td></tr>
<tr><td>1 Environmental Biotechnology, Paper - I
STPG04BTH001
Theory = 03 Credit
Theory = 100 (80 + 20)</td><td rowspan="4">(4x2)08

(2x2)4</td><td>1. Ethics, Patenting ,Bio entrepreneurship And Biostatistics
Paper -III STPG04BTH002
04credit
Theory = 100 (80 + 20)</td><td rowspan="4">4</td><td rowspan="4">Research Project STPG04BTH009</td><td rowspan="4">6</td><td rowspan="4">22</td></tr>
<tr><td></td><td>2.Nanobiotechnology, Paper - III
STPG04BTH005
04 credit
Theory = 100 (80 + 20)</td></tr>
<tr><td>2. Applied Environmental Biotechnology And Ecology. Paper - II
STPG04BTH002
3. Theory = 03credit
Theory = 100 (80 + 20)</td><td>3.Cancer Biology, Paper – III
STPG04BTH006
04credit
Theory = 100 (80 + 20)</td></tr>
<tr><td></td><td>4..DNA Fingerprinting, Paper - III STPG04BTH007
04credit
Theory = 100 (80 + 20)</td></tr>
<tr><td>Practical I
Based on Paper 1- Environmental Biotechnology
02credit
STPG04BTH010
Practical II
Based on Paper II Applied Environmental Biotechnology And Ecology
02credit
STPG04BTH011</td><td></td><td>5. Molecular Basis Of Drug Discovery,
Paper - IV
STPG04BTH008
Theory = 03 credit
Theory = 100 (80 + 20)</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Note:- Student shall select anyone from above group</td><td></td><td></td><td></td><td></td></tr>
</table>

Course Outcomes and Course Content

Semester	**IV**
Paper Code	**STPG04BTH001**
Paper Title	**Environmental Biotechnology**
Number of teaching hours per week	**4**
Total number of teachings hrs per semester	**60**
Number of credits	**4**

COURSE OBJECTIVE

Environmental education, need for environmental education, Interaction of Environmental Components Bio-Energy: non-conventional or renewable sources of energy, Energy from biomass: petroleum plants, alcohol, biogas andhydrogen, Biogeochemical cycles

Unit 1 : Global Environmental Problems	15Hrs
A. Environmental education, need for environmental education. B. Environmental pollutants: classification of pollutants. C. Air pollution- air quality, sources, ecology and pollutants. D. Water pollutants- types of water pollution, water pollutants(organic, inorganic, microbial, radioactive), eutrophication. E. Ozone depletion, green-house effect and acid rain.	
Unit2 : Interaction of Environmental Components	15Hrs
F. Ecosystem structure and functions, abiotic and biotic component. G. Ecological pyramids-types. H. Biotechnological processes: bioconversion, bioaccumulation, bioconcentration, biomagnification, and biodegradation. I. Degradation of xenobiotics in environment: ecological considerations, decay behavior and degradative plasmids	
Unit 3 : Bioresources and Bioenergy	15Hrs
A. Biogeochemical cycles: - (nitrogen, carbon, phosphorous and sulphur) B. Need for Bioresources C. Bio-Energy: non conventional or renewable sources of energy D. Energy from biomass: petroleum plants, alcohol, biogas and hydrogen. E. Biochips, biofilters, biofuel cells and their uses.	
Unit 4 : Soil Fertility and Pest Management	15Hrs
A. Biological nitrogen fixation- symbiotic and non-symbiotic nitrogen fixation, mechanism, *nif* gene, Role of rDNA technologyin nitrogen fixation. B. Biofertilizers- bacterial biofertilizers, algal biofertilizers, C. Biopesticide and integrated pest management: D. Aquatic ferns as biofertilizers, fungi as biofertilizers, earthworm as biofertilizers.	

Suggested Readings

1. Mooray Moo-Young. (Eds). Comprehensive Biotechnology (Vol. I, II, III) Pergamon Press,England.
2. Metcalf and Eddy. Waste water engineering treatment and uses. McGraw Hill.
3. Jogdand, S.N. Environmental Biotechnology. Himalaya Publication House.
4. De, A.K. Environmental Chemistry. Wiley Eastern Ltd.
5. Abbasi and Abbasi. Renewable Energy Sources and their environmental impact. PrenticeHall of India, Pvt. Ltd.
6. Chatterji, A.K. Introduction to Environmental Biotechnology. Prentice Hall of India.
7. Thakur, I. S. Text Book of Environmental Biotechnology. I. K. International Publisher, NewDelhi.
8. Mohapatra, P. K. Text Book of Environmental Biotechnology. I. K. International Publisher,New Delhi.

Semester	**IV**
Paper Code	**STPG04BTH002**
Paper Title	**Applied Environmental Biotechnology and Ecology**
Number of teaching hours per week	**4**
Total number of teaching hrs per semester	**60**
Number of credits	**4**

COURSE OBJECTIVE

Waste water: composition biological waste water treatment, Genetic aspects of heavy metal resistance in cyanobacteria and fungi, Brief idea of land use planning and management, Detection of pathogenic organism

Unit 1 : Measurement of Water Pollution	15Hrs
Waste water: composition, types Measurement of water pollution- BOD (biological oxygen demand), COD (chemical oxygen demand) Detection of pathogenic organism: laboratory methods (MTFT, MFT) Techniques to detect fecal from non-fecal bacteria: IMViC test	
Unit 2 : Waste Water Treatment	15Hrs
A. Waste water treatment: classification, types B. Biological waste water treatment: aerobic, anaerobic, activated sludge, trickling filter, rotating biological contactor, anaerobic digester. C. Waste water treatment by biofilms. D. Treatment scheme of industries: dye, pulp and paper, petroleum, dairy, distillery, tannery, sugar industries	
Unit 3 : Biodegradation and Bioremediation	15Hrs
A. Xenobiotics in environment: biodegradation of hydrocarbons, substituted hydrocarbons, surfactant, pesticides, lignin, tannin, synthetic dyes, B. Bioabsorption and bioleaching of heavy metals: cadmium, lead, mercury, metal binding targets, advantages and disadvantages of bioleaching. C. Biomethylation of elements (methylation of mercury and arsenic) D. Genetic aspects of heavy metal resistance in cyanobacteria and fungi	
Unit 4 : Ecology	15Hrs
A. Mineral resources and their conservation-terrestrial mineral resources. B. Ecological aspects of mining. C. Biodiversity- biotechnological methods of conservation, cryopreservation and micropropagation. D. Forest conservation-forest cover, deforestation, afforestation (protective and exploitative forestry) E. Wildlife management-tiger reserve in India. F. Brief idea of land use planning and management	

Suggested Readings

1. Mooray Moo Young. (Eds). Comprehensive Biotechnology (Vol.I,II,III) Pergamon Press, England.
2. Metcalf and Eddy. Waste water engineering treatment and uses. McGraw Hill.
3. Jogdand, S. N. Environmental Biotechnology. Himalaya Publication House.
4. De, A.K. Environmental Chemistry. Wiley Eastern Ltd.
5. Abbasi and Abbasi. Renewable Energy Sources and their environmental impact. Prentice Hall of India, Pvt. Ltd.
6. Chatterji ,A. K. Introduction to Environmental Biotechnology. Prentice Hall of India.
7. Thakur, I. S. Text Book of Environmental Biotechnology. I. K. International Publisher, New Delhi.
8. Mohapatra, P. K. Text Book of Environmental Biotechnology .I.K. International Publisher, New Delhi. Biotechnology: B.D. Singh, Kalyani Publication.
9. Biotechnology: U. Satyanarayan, Books & Allied Pvt.Ltd.
10. Biotechnology: V. Kumarsen, Saras Publication.
11. Environmental Biotechnology: S.V.S. Rana, Second edition.
12. Biotechnology- Rehm and Reid.
13. Waste water microbiology by G. Bitton
14. Biodegradation and bioremediation by M. Alexander
15. Waste water treatment for pollution control, 2nd edition. Arceivala Environmental Biotechnology by H. Jordening

ELECTIVE PAPERS

Semester	**IV**
Paper Code	**STPG04BTH003**
Paper Title	**Ethics, Patenting, Bio entrepreneurship and Biostatistics**
Number of teaching hours per week	**4**
Total number of teaching hrs per semester	**60**
Number of credits	**4**

Course Outcomes

1.Ethics: benefits of biotechnology, Recombinant therapeutic products for human health care, Patenting And Intellectual property rights.

2. Concept of Bio-entrepreneurship, Pillars of bio-entrepreneurship, promoting bio-entrepreneurship.

3. Bio-Entrepreneurship efforts in India, difficulties, organization supporting biotech growth in India, area of scope, funding agencies in India, biotech policy initiatives

Unit 1 : Ethics	15Hrs
A. Ethics: benefits of biotechnology B. Recombinant therapeutic products for human health care. C. Genetic modifications and food consumption, D. Release of genetically engineered organisms, E. Applications of human genetic rDNA research, human embryonic stem cell research. F. Environmental legislation, quality control in biotechnology	
Unit2: Patenting and Biosafety	15Hrs
G. Patenting: patent and trademark, H. Intellectual property rights, plant breeders rights, I. Biotechnology in developing countries. J. Biotechnology products and processes, K. Biosafety and its implementation, L. Quality control in biotechnology	
Unit 3 : Bio-Entrepreneurship-I	15Hrs
A.Concept of bio-Entrepreneurship: definition, factors necessaryfor entrepreneurship, desirable in a startup. A. Pillars of bio-entrepreneurship, promoting bio-entrepreneurship B. Biotech company roadmap- biofertilizer company. C. Legal regulatory and other business factors forentrepreneurship	
Unit 4 : Biostatistics	15Hrs
Introduction to Biostatistics A. A. Methods of sampling, sampling error, non-sampling errors, standard error. B. B. Measures of central tendency: mean, mode, and median. C. Measures of dispersion: range, mean deviation, standard deviation. D. D. Probability.	

Suggested Readings

1. Text Book of Biotechnology–By H.K. Das (Wiley Publications)
2. Biotechnology–By H.J. Rehm and G. Reed. VIH Publications, Germany
3. Text Book of Biotechnology- By S.N. Jogdand
4. Bioethics– Readings and Cases- By B.A. Brody and H. T. Engelhardt. Jr. (Pearson Education

Semester	**IV**
Paper Code	**STPG04BTH005**
Paper Title	**Nanobiotechnology**
Number of teaching hours per week	**4**
Total number of teaching hrs per semester	**60**
Number of credits	**4**

Course Outcomes:

1. Concepts, historical perspective and overview of nanoscale materials.
2. Effect of length scale on properties.
3. Different methods of nanomaterial synthesis.
4. Characterization and analysis of nanoparticles by different techniques.
5. Nanoparticles for diagnostics and imaging.

Unit 1 Introduction to Bio nanotechnology	15Hrs
A. Concepts, historical perspective and overview of nanoscale materials B. Effect of length scale on properties; challenges and opportunities associated with biology on the Nanoscale, C. Nanotechnology in Nature (Lotus effect, Gecko Effect and Iridescence Phenomena); Biomimetic etc	
Unit 2 : Nanomaterial Synthesis	15Hrs
A. Top-down and bottom-up approach of nanomaterial Synthesis, B. Different methods of nanomaterial synthesis (Physical, Chemical, Biological and Hybrid), C. Synthesis of Nanoparticles by Biological system, D. Extracellular biosynthesis with a case study of silver and gold nanoparticles, E. Intracellular biosynthesis case by Bacteria	
Unit 3 : Characterization Techniques	15Hrs
A. Characterization and analysis of nanoparticles by different techniques such as UV-Visible spectroscopy, Nuclear Magnetic Resonance (NMR), B. Electron Microscopy (SEM, TEM, STEM) , C. Probe Microscopy (AFM), X-RD, FTIR, ICP-MS etc	
Unit 4: Applications of nanomaterials	15Hrs
A. Nanoparticles for diagnostics and imaging (theranostics) B. concepts of smart stimuli responsive nanoparticles, C. Implications in cancer therapy, D. nanodevices for biosensor development, E. Nanomaterials for catalysis, development and characterization of nanobiocatalysts. F. Applications of Nano biocatalysis in the production of drugs	

Suggested Readings

1. Gero Decher, Joseph B. Schlenoff, (2003); Multilayer Thin Films: Sequential Assembly of Nanocomposite Materials, Wiley-VCH Verlag GmbH & Co. KGaA
2. David S. Goodsell, (2004); Bionanotechnology: Lessons from Nature; Wiley-Liss
3. Neelina H. Malsch (2005), Biomedical Nanotechnology, CRC Press
4. Greg T. Hermanson, (2013); Bioconjugate Techniques, (3rd Edition); Elsevier

Semester	**IV**
Paper Code	**STPG04BTH006**
Paper Title	**Cancer Biology**
Number of teaching hours per week	**4**
Total number of teaching hrs per semester	**60**
Number of credits	**4**

Course Outcomes:

1. analyses the changes in the cells leading to cancer
2. formulate new assay systems for detection of cancer.
3. Get motivated to design markers.
4. help develop new drugs

Unit 1 : Hallmarks of cancer	15Hrs
A. Cancer: Introduction to cancer, B. The nature of cancer cancer types and their prevalence, C. Hall Marks of Cancer: Evasion of Apoptosis, Limitless replicative potential, Sustained D. Angiogenesis, Inflammation. E. Diseased and cancerous cell: morphological and microscopic features, important tumor markers	
Unit 2 : Molecular basis of Key Players	15Hrs
F. Carcinogens, tumor virology, oncogenes, tumor suppressor genes, G. Cell cycle regulation in cancer development, role of genomic instability in cancer pathogenesis, H. Histone acetylases/deacetylases in cancer progression, I. Understanding of post transcriptional and post translational modifications in cancer cell, J. Angiogenesis and malignancy, stem cell biology & cancer stem cells.	
Unit 3 : Altered pathways	15Hrs
A. Hypoxia/ tumor cell microenvironment and important signaling pathways involved in cancer progression, Pathways involved in cell differentiation/ immortalization in cancer. B. Systems Biology in cancer, epigenetics in cancer, C. MicroRNAs and cancer, cell death: necrosis and apoptosis.	
Unit 4: Conventional and new treatments	15Hrs
A. Discovery and clinical validation of a targets in cancer, tools, techniques & important parameters involved in screening new bioactive(s) as possible anticancer agent(s), B. Cell cycle regulators: Role as therapeutic targets in cancer, gene silencing and RNAi technology in cancer treatment.	

Suggested Readings

1. The Biology of Cancer. Weinberg R. A. (2013), 2nd Ed. Garland Publishing Inc, ISBN-10 : 0815342209, 978-0815342205
2. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics. Pecorino Lauren, (2021), 5th Ed. OUP Oxford, ISBN-10 : 0198833024, 978-0198833024
3. The Cell: A Molecular Approach. Cooper G. M and Housman R. E, (2009), 5th Ed. Sinauer Associates Inc, ISBN-10 : 0878933972, 978-0878933976

Semester	**IV**
Paper Code	**STPG04BTH007**
Paper Title	**DNA Fingerprinting**
Number of teaching hours per week	**4**
Total number of teaching hrs per semester	**60**
Number of credits	**4**

COURSE OUTCOMES:

1. History of DNA profiling.
2. Multilocus probes, locus specific probes, applications in Forensic science.
3. Classification of STR, history of STR for DNA profiling, STR profiling used for sex determination, problems of Amelogenin markers, advantages and disadvantages of STR based DNA profiling, problems of DNA profiling

Unit 1 : RFLP base DNA Fingerprinting	15Hrs
A. History of DNA profiling, B. RFLP based DNA profiling, C. Multilocus probes, locus specific probes,applications in Forensic science, D. Advantages and disadvantages of RFLP based DNA profiling	
Unit 2 : PCR based DNA Fingerprinting	15Hrs
A. PCR STR based DNA profiling, B. Automation in detection of PCR STR profile, C. Classification of STR, history of STR for DNA profiling, STR profiling used for sex determination, problems of Amelogenin markers, advantages and disadvantages of STR based DNA profiling, problems of DNA profiling	
Unit 3 : Linage markers	15Hrs
A. Lineage marker: mt DNA, method of mt DNA analysis, B. Y-STR profiling, methodology for Y STR analysis, Y STR database and its application, technique, Applications of lineage markers. C. Problems of Linage markers.	
Unit 4: DNA analysis: Legal system, application of database, ethics and social implication	15Hrs
A. DNA and Legal system in India, Indian DNA bill, B. DNA fingerprinting database, Combined DNA Indexing System (CODIS). C. Forensic genetics and ethical, legal and social implications	

Suggested Readings

1. Gill et al (1985) Forensic application of DNA Fingerprints. Nature 318, 577.
2. Jefferys et al (1985) Individual specific DNA fingerprints of Human DNA. Nature 316, 76.
3. Jefferys et al (1985) Positive identification of an immigration test case using human DNA fingerprints. Nature 317,818.
4. Jefferys et al (1985) Hypervariable Minisatellite regions in human DNA Nature, 314, 67
5. Rogave et al (2008) Genomic identification in the historical case of the Nicholas II royal family, PNAS www.pnas.org/cgi/content/full/0811190106/DCSupplemental
6. Clobel et al (2009) The Identification of the Two Missin g Romanov Children Using DNA Analysis, Plos 4, e4838
7. Wayman and White (1980) A highly polymorphic locus in human DNA, Proc. Nati. Acad. Sci. USA Vol. 77, No. 11, pp. 6754-6758,
8. An Introduction to Forensic Genetic (2007) William Goodwin ed John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England

Semester	**IV**
Paper Code	**STPG04BTH008**
Paper Title	**Molecular Basis of Drug Discovery**
Number of teaching hours per week	**4**
Total number of teaching hrs per semester	**60**
Number of credits	**4**

COURSE OUTCOMES:

1. Interpret relationships between molecule concentration and enzyme or receptor activity
2. Compute a molecule's pharmacokinetic parameters from *C*p-time data points
3. Correlate a molecule's structure to its metabolic behavior
4. Prioritize the viability of weakly active molecules for potential drug development
5. Propose molecules with improved properties based upon data from related structures

Unit 1 : Pre-Regulatory Medicine:	15Hrs
A. Pre-Regulatory Medicine: Natural products, Early Synthetic drugs, B. Pharmacophores, Need forRegulations. C. Drug development outline, D. Target based drug discovery and Phenotype based discovery, E. Drugrepurposing. Concept to market	
Unit 2 : Proteins and their structures	15Hrs
A. Proteins and their structures, B. Enzymes: Enzyme kinetics, Enzyme inhibition and itsmeasurements, C. IC50 and Ki, Receptors and Ligands, D. Occupancy theory: Emax and Kd, Bindingand Response, Up regulation and down-regulation	
Unit 3 : Molecular Basis of Drug Discovery	15Hrs
A. Binding, Structure and Diversity: Intermolecular forces, B Drug Target Complementarity, C. Molecular diversity, Molecular libraries, Building libraries.	
Unit 4: Lead Discovery	15Hrs
A. Lead Discovery: In vitro screening, fragment-based screening, Filtering hits, B. Selectiveoptimization of side activities, Natural products C. Lead optimization: functional group replacements, Alkyl group replacements, Isosters, D. DirectedCombinatorial Libraries, Peptidomimetics	

Suggested Readings

1. MEDICINAL CHEMISTRY: THE MOLECULAR BASIS OF DRUG DISCOVERY: Medicinal Chemistry Made easy. Barnabas Ifitumi Samuel .ISBN-13: 979-8458903875
2. Basic Principles of Drug Discovery and Development. (11th Edition). Benjamin Blass. ISBN: 9780124115255
3. Drug Discovery and Evaluation Pharmacological Assays (2nd Edition). H. Gerhard Vogel (Ed.). ISBN 3- 540-42396-6 Springer-Verlag
4. Computer-Aided Drug Design Virtual Lab https://vlab.amrita.edu/index.php?sub=3&brch=277

Practical Based on Major Paper I- ENVIRONMENTAL BIOTECHNOLOGY
Course Code: STPG04BTH010

02credit

Practical I (ENVIRONMENTAL BIOTECHNOLOGY)
Compulsory Practical
1.Production of Microbial Biofertilizers. (Rhizobium/ Azatobacter)
2. Determine the efficiency of removal of air pollutant using fibrous air filter.
Optional Practical

1. Determination of percentage of green house gases in environment.
2. Effect of Mycorrhizal fungi on growth promotion of plants
3. Preparation and formulation of microbial biopesticide (bacteria, fungi)
4. Isolation of xenobiotic degrading bacteria by selective enrichment technique.
5. Survey of degradative plasmids in microbes growing in polluted environment

NOTE: In addition to 2 compulsory practicals at least 4 optional practicals must be conducted within the semester.

Practical Based on Major Paper II- APPLIED ENVIRONMENTAL BIOTECHNOLOGY
Course Code: STPG04BTH010
02credit

Practical II (APPLIED ENVIRONMENTAL BIOTECHNOLOGY)
Compulsory Practical
1. Detection of fecal and non-fecal bacteria by IMViC test.
2. Determination of chemical oxygen demand (COD) of sewage sample.
3. Preparation of research proposal and presentation.
Optional Practical

1. Determination of total dissolved solids of water
2. Determination of hardness and alkalinity of water sample.
3. Determination of dissolved oxygen concentration of water sample
4. Determination of biological oxygen demand of sewage sample.
5 .Test for the degradation of a aromatic hydrocarbons by bacteria.
6.Estimation of heavy metals in water/soil by atomic absorption spectrophotometry,
7. Estimation of nitrate in drinking water.

NOTE: In addition to 3 compulsory practicals at least 4 optional practicals must be conducted within the semester.

PROJECT/DISSERTATION GUIDELINES

DISSERTATION/PROJECT WORK SCHEME/GUIDELINES FOR THE STUDENTS, SUPERVISORS AND EXAMINERS:

Every student is required to carry out Experimental Project Work on a related research topic of the subject/ course. It must be an original work and must indicate some degree of experimental work. On the basis of this work, student must submit the project Report typed and properly bound) in two copies at least one month prior to commencement of the final Practical/lab examination of Semester IV. The project report shall comprise of Introduction, Material and Methods, Result, Discussion, Summary, Conclusion and, References along with declaration by candidate that the work is original and not submitted to any other University or Organization for award of degree and certificate by the supervisor and forwarded through head/Course-coordinator/Director of the Department/Centre or the Principle of the college. The topic for project work will be assigned to the student by supervisor at the beginning of third semester. The topic will be forwarded to the controller of examination by the head of the department. Student will present his/her details of Project/Dissertation in PPT form on the day of final exam of project. The project work will be evaluated by both external and internal examiner in the respective Department/Center/Affiliated College.

Project must contain following subsection: -

1. Introduction,
2. Aims and Objectives,
3. Review of Literature,
4. Materials and Methods,
5. Experiments and Results,
6. Discussion,
7. Conclusion and References.

50% marks each shall be evaluated by external and 50% marks each shall be evaluated by Internal Examiner